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13. ABSTRACT *(Maximum 200 Words)*

The graduate students supported by this AASERT obtained research training in the application of mathematical modelling, analysis and computation to the improvement of active materials. The central focus of this work was on the development of specific strategies to improve present materials and on the design of new materials and composites.

Rob Tickle studied a promising alloy system Ni-Mn-Ga for the presence of magneto-memory and obtained reversible strains that are currently the largest field-induced strains that have been observed under moderate field.

James Riordan developed a piecewise linear nonconforming finite element method for the computation of microstructure in martensitic active materials.

Tim Brule worked on the development and analysis of numerical algorithms to compute the deformation of thin martensitic films for application in microvalves, micropumps, or other micromachines.

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University of Minnesota
August 10, 1999

The AASERT funds supported the research of several graduate students. Robert Tickle's research has lead to fundamental theoretical and experimental advances on the ferromagnetic shape memory effect. These advances include:

1. A new theory of the ferromagnetic shape memory effect, with detailed predictions of domain structure and macroscopic behavior. The main advances were guided by this theory.

2. An understanding of the crucial role of magnetic anisotropy in the martensitic phase. Also, the first measurements of magnetic ansiotropy in Ni_2MnGa. A strategy for searching for new ferromagnetic shape memory materials was developed.

3. A theoretical prediction and subsequent experimental verification of the important (but unexpected) role of specimen shape on the magnetomechanical behavior of ferromagnetic shape memory materials.

The AASERT funds supported graduate student James Riordan. Riordan developed a numerical analysis of the piecewise linear nonconforming finite element method for the computation of microstructure. His results demonstrated the convergence of the microstructure at an asymptotic rate equal to the conforming method, and his numerical experiments indicate promise that this method can be more efficient than conforming methods. This work has been reported in Riordan's Ph.D. thesis and will be reported in a forthcoming paper with Bo Li and Mitchell Luskin.

Tim Brule, a graduate student in mathematics, was also supported to work on the development and analysis of numerical algorithms to compute the deformation of thin martensitic films for application in microvalves, micropumps, or other micromachines. He used the model for the deformation

of thin martensitic films developed by Bhattacharya and James. Brule is currently preparing his research for a thesis and for future publication.

References

[1] R. D. James, R. Tickle, and Manfred Wuttig. Large field-induced strains in ferromagnetic shape memory materials. *Materials Science and Engineering A*, to appear.

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